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Suggested Grade

9

SD Mathematics Strands & Standards (*Primary for Task*)

Algebra

9-12.A.1.1. (Knowledge Comprehension) Write equivalent forms of algebraic expressions using properties of the set of real numbers.

Task Summary

Students create a card or board game matching algebraic expressions in factored form with their equivalent expressions in expanded form.

Time and Context of Task

Students work in small groups (2-4 per group)

Approx. 4 class periods: 1 period for exploration, 3 periods for game construction and revisions

Materials Needed

Computer lab access for **Introduction/Review** portion of the activity (see instructor notes)

Paper, pencil, tag board, construction paper, markers, scissors, etc. for game construction

Explore/Discover

- Go to the National Library of Mathematics Manipulatives (Utah State University) at <http://nlvm.usu.edu/en/nav/index.html>
- Click on the link to Virtual Library - <http://nlvm.usu.edu/en/nav/vlibrary.html>
 - Select Algebra 9-12 on the grid - http://nlvm.usu.edu/en/nav/category_g_4_t_2.html
 - Select Algebra Tiles - http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities
- Use the applet to explore polynomial multiplication. Follow the directions to complete activities 1-8.
- Describe the process of polynomial multiplication in paragraph form.

Author and Lead Teacher for This Task

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Consider games in which players identify a pair of expressions, for example: *Go Fish*, *Old Maid*, *Dominoes*, *Concentration*, and *Bingo*. Players identify two items that form a matching pair.

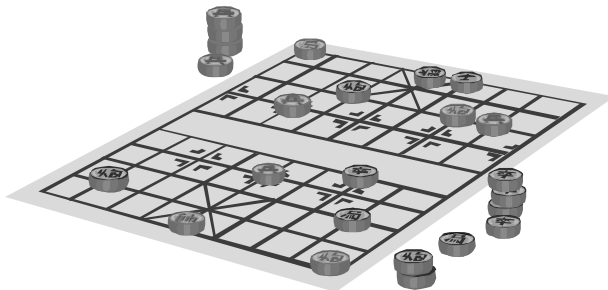
Create a card or board game matching algebraic expressions in factored form with their equivalent expressions in expanded form.

Example: $2(x + 3)$ and $2x + 6$.

Your game should include the following components:

- A written set of directions with one or more examples
- Game board and/or game pieces
- Expressions of various difficulty levels: Distributive property, Multiply 2 binomials, Binomial x Trinomial, etc.
- A descriptive and creative name for the game

After creating the game, trade games with another group and provide specific feedback. Consider the feedback provided to your group. Modify your rules and/or game pieces to improve your game.



CONTENT STANDARDS

Primary Standard for the Task

Strand Name: Algebra

SD Goal: Students will use the language of algebra to explore, describe, represent, and analyze number expressions and relations that represent variable quantities.

Indicator 1: Use procedures to transform algebraic expressions.

Standard: 9-12.A.1.1. (Knowledge Comprehension) Write equivalent forms of algebraic expressions using properties of the set of real numbers.

NCTM Process Standards

Communication:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers and others
- Use the language of mathematics to express mathematical ideas precisely

Representation:

- Select, apply and translate among mathematical representations to solve problems

Problem-Solving Strategies

- Working backward
- Simplifying the problem
- Acting out the problem
- Use of manipulatives

Assessment Tools

Task Rubric

CATEGORY	Advanced	Proficient	Basic	Below Basic
Standard: 9-12.A.1.1 Write equivalent forms of algebraic expressions using properties of the set of real numbers	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Accuracy of Content	All information cards and/or game pieces made for the game are correct.	All but one of the information cards and/or game pieces made for the game are correct.	All but two of the information cards and/or game pieces made for the game are correct.	Several information cards and/or game pieces made for the game are not accurate.
Rules	Rules were written clearly enough that all could easily participate.	Rules were written, but one part of the game needed slightly more explanation.	Rules were written, but people had some difficulty figuring out the game.	The rules were not written.
Knowledge Gained	All students in group could easily and correctly state several facts about the topic used for the game without looking at the game.	All students in the group could easily and correctly state 1-2 facts about the topic used for the game without looking at the game.	Most students in the group could easily and correctly state 1-2 facts about the topic used for the game without looking at the game.	Several students in the group could NOT correctly state facts about the topic used for the game without looking at the game.
Attractiveness	Contrasting colors and at least 3 original graphics were used to give the cards and gameboard visual appeal.	Contrasting colors and at least 1 original graphic were used to give the cards and gameboard visual appeal.	Contrasting colors and "borrowed" graphics were used to give the cards and gameboard visual appeal.	Little or no color or fewer than 3 graphics were included.
Creativity	The group put a lot of thought into making the game interesting and fun to play as shown by creative questions, game pieces and/or game board.	The group put some thought into making the game interesting and fun to play by using textures, fancy writing, and/or interesting characters.	The group tried to make the game interesting and fun, but some of the things made it harder to understand/enjoy the game.	Little thought was put into making the game interesting or fun.

Rubric created using Rubistar <http://rubistar.4teachers.org/index.php>

**Core High School Algebra
Performance Descriptors**

Advanced	High school students performing at the advanced level: <ul style="list-style-type: none"> • transform algebraic expressions; • solve quadratic equations; • solve a system of linear equations.
Proficient	High school students performing at the proficient level: <ul style="list-style-type: none"> • transform polynomial expressions using real number properties; • solve single variable linear equations with integral coefficients; • graph linear equations; • interpret tables, graphs, and charts to solve problems; • create a linear model from a problem context.
Basic	High school students performing at the basic level: <ul style="list-style-type: none"> • transform linear expressions with integral coefficients using real number properties; • solve linear equations of the form $ax + b = c$, where a, b, and c are integers; • recognize the graph of a linear equation; • graph a line from a table of values.

**Core High School Algebra
ELL Performance Descriptors**

Proficient	High school ELL students performing at the proficient level: <ul style="list-style-type: none"> • solve, transform, and graph linear equations; • apply algebraic representations to solve problems; • read, write, and speak the language of algebra and apply it to algebraic problem-solving situations.
Intermediate	High school ELL students performing at the intermediate level: <ul style="list-style-type: none"> • solve one-variable linear equations; • graph linear equations in slope-intercept form; • complete tables to graph linear equations; • create numerical expressions from oral or written contexts; • evaluate an algebraic expression given the value of the variable(s); • explain in algebraic terms the steps and/or strategies used in problem solving; • give oral, pictorial, symbolic (diagrams) or written responses to questions on topics presented in class.
Basic	High school ELL students performing at the basic level: <ul style="list-style-type: none"> • graph points on a coordinate system; • solve problems with integral and rational solutions; • evaluate numerical expressions; • demonstrate problem-solving strategies; • break tasks into smaller parts and make connections to prior knowledge; • recognize, compare, and use appropriate algebraic terms; • respond to yes or no questions and to problems presented pictorially or numerically in class.
Emergent	High school ELL students performing at the emergent level: <ul style="list-style-type: none"> • identify and use mathematical symbols; • copy and write numerals and algebraic symbols; • imitate pronunciation of numerals and mathematical terms; • use non-verbal communication to express mathematical ideas.
Pre-emergent	High school ELL students performing at the pre-emergent level: <ul style="list-style-type: none"> • observe and model appropriate cultural and learning behaviors from peers and adults; • listen to and observe comprehensible instruction and communicate understanding non-verbally.

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Student Work Samples



As you examine the samples, consider the following questions:

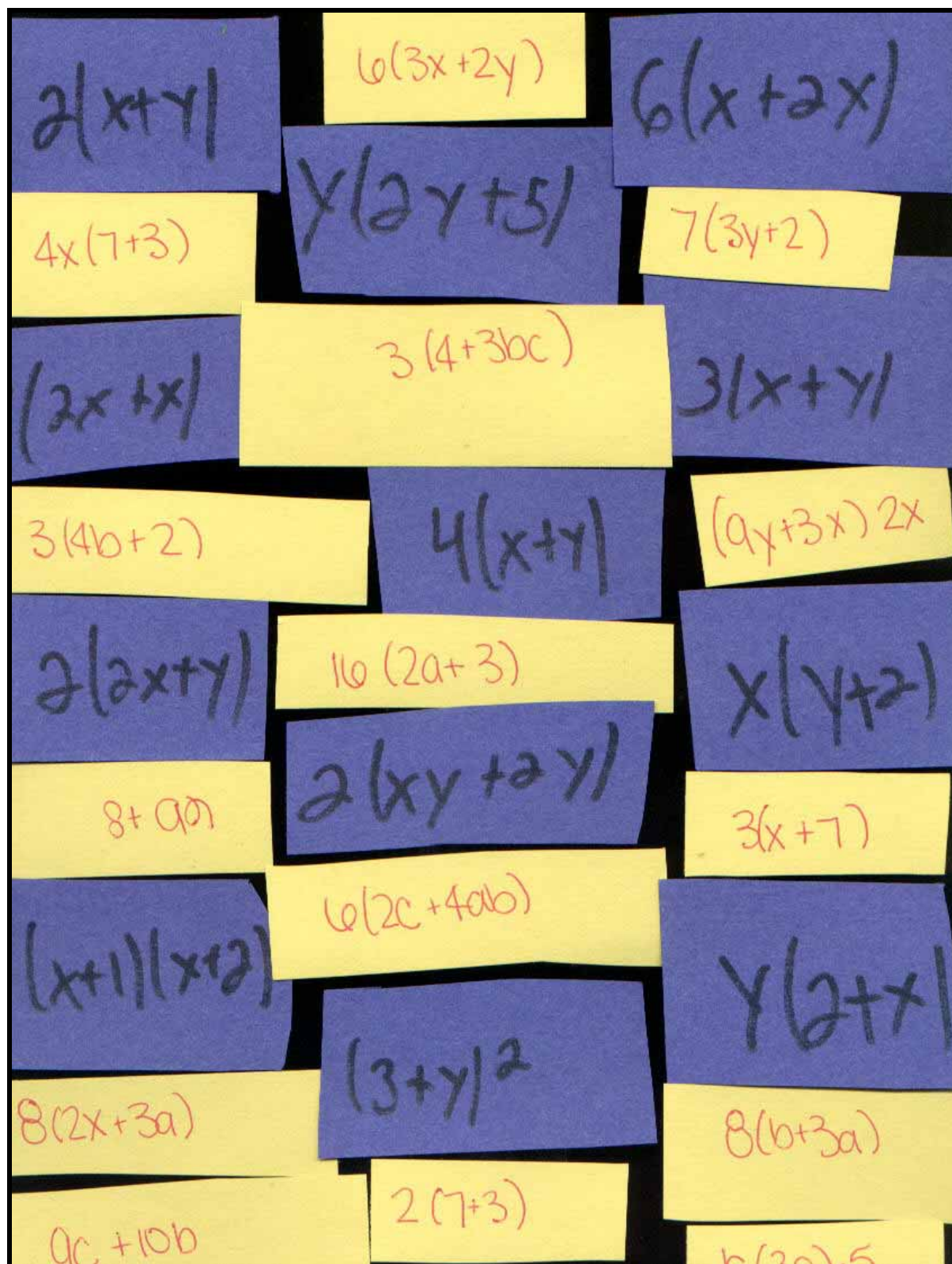
- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

Student Work Sample #1

DIRECTIONS

1. Down the middle, you will see 3 free spaces you cannot win off of free- put a square on them.
2. Play the game until you see that you have 5 in a row- up or down- or diagonally.
3. Read off the card, what your equation is. Partners take turns picking cards. Figure it out, once you find the answer put a square on it. Repeat until you have all 5 spaces filled. Once you have a LET'S PLAY! You have won the game... Good Job.
4. Clear your game pieces off, and play again!

Similar 2: Bingo



Sample #1 – page 3

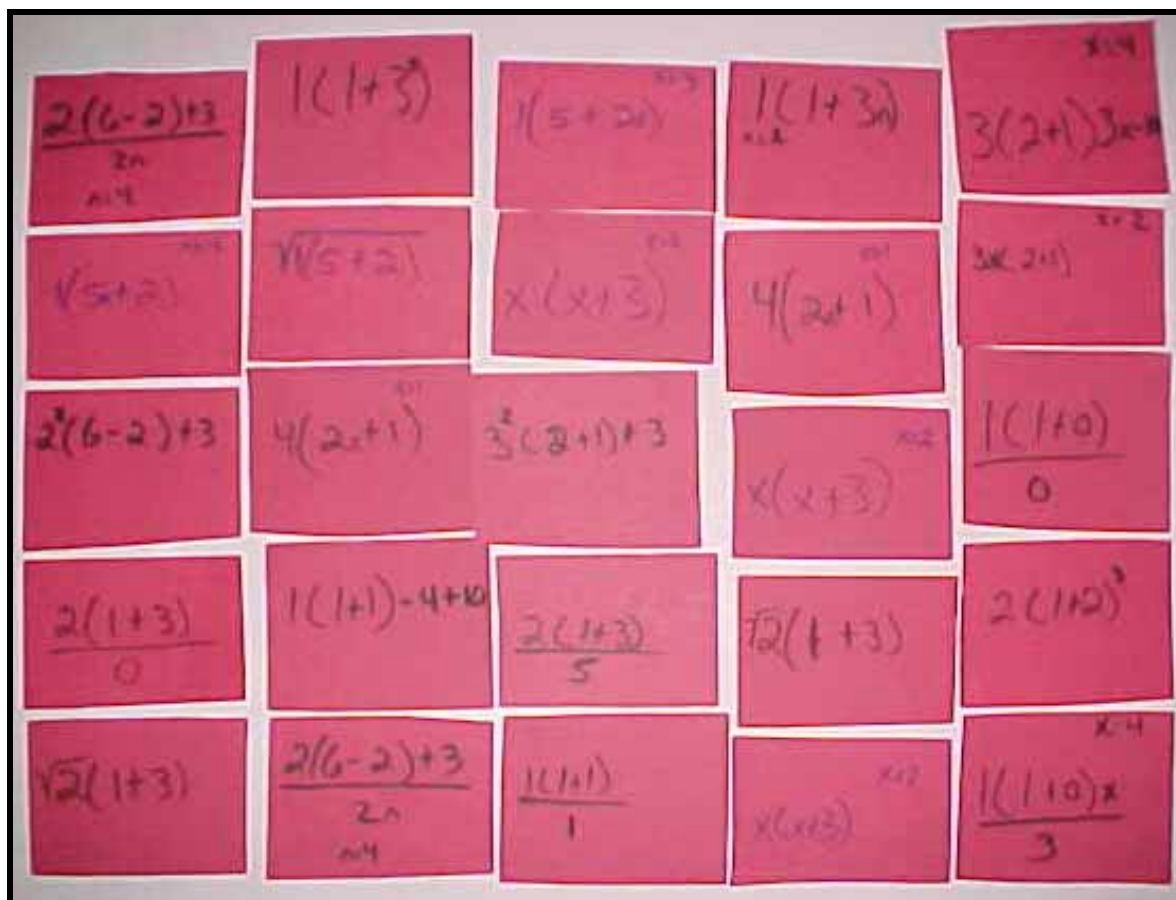


Looking at Student Work – Instructor notes and rating for work sample #1:

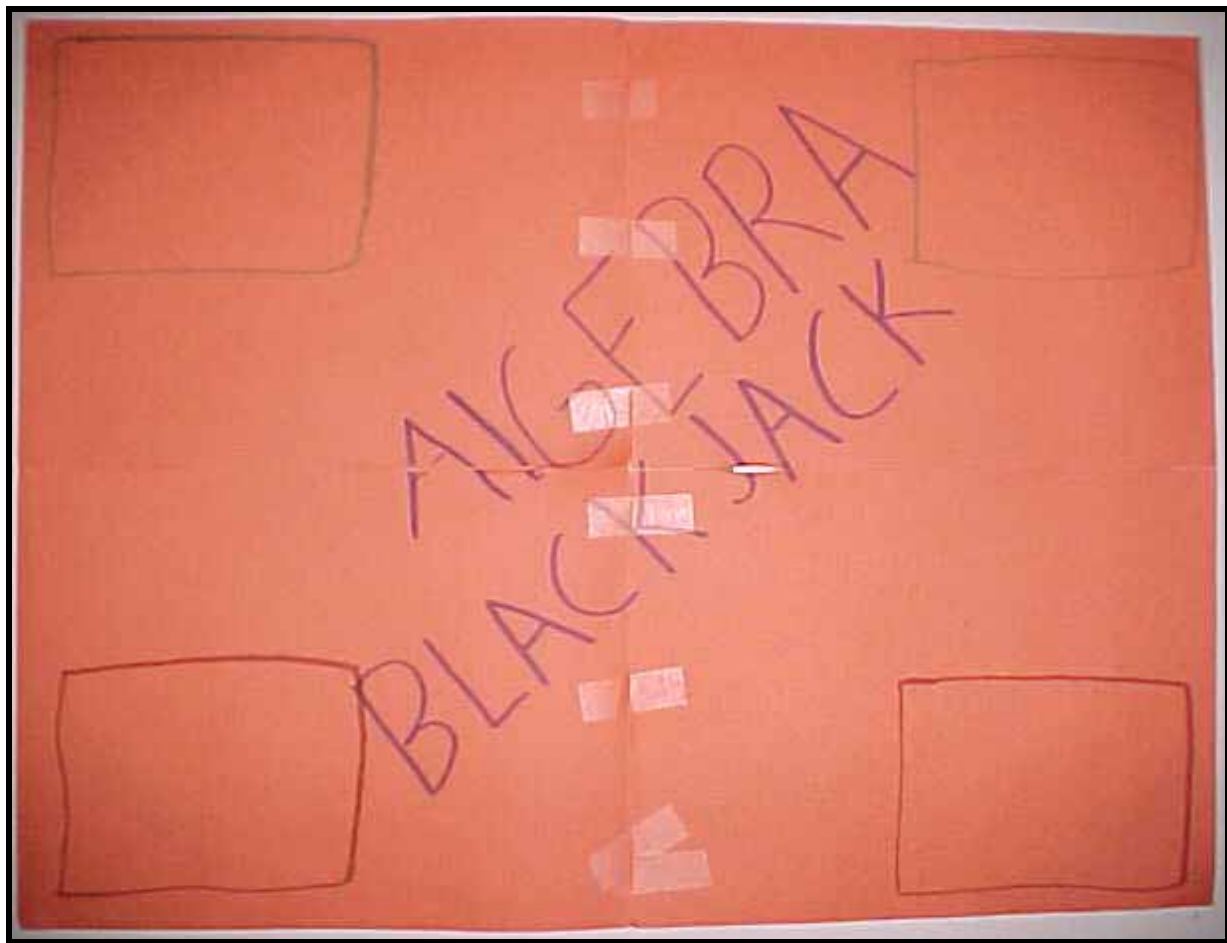
The “Bingo” project was scored as proficient. The game’s construction showed substantial understanding of the mathematical concepts and all game pieces made for the game were correct. All students in the group could easily state facts about the topic without looking at the game.

Rules were well written, only a few typos were observed. The group put some thought into making the game interesting and fun to play by using fancy writing, graphics, and colorful game pieces.

Student Work Sample #2



Sample #2 – page 2



Looking at Student Work – Instructor notes and rating for work sample #2:

The “Blackjack” project was rated as basic. The students’ explanation showed understanding of the mathematical concepts, but they tended to use very easy problems. All but one of the game pieces was correct, and students in the group could easily state facts about the game. Written rules were fairly clear; some mention of how to handle decimals and undefined terms would have been helpful. A few typos interfered with rule interpretation.

Little or no color and no graphics were included in the game construction. The group tried to make the game interesting and fun, but some of the features made it harder to understand/enjoy the game.

INSTRUCTIONAL NOTES

Author comments

- Instead of using a computer for the **Explore/Discover** activity, algebra tiles could be used to complete the activity.
- It may not be practical to post examples of student games. Perhaps a scan or photo of game boards and/or game pieces will be possible.
- This activity will be field tested with students enrolled in “Basic Algebra I” after a unit on algebraic expressions. I plan to have the regular “Algebra I” students play the games as a skills review.
- Since students take more seriously what is evaluated, I anticipate that the project evaluation (point grade) will count approximately $\frac{1}{2}$ that of a test grade.

The project was field tested with a “basic algebra” class of sophomores and one senior. Students in this class can be generally categorized as reluctant math learners. After a unit with order of operations, and using properties (distributive property, etc.) students were given the assignment. It was positively received, and students were grouped into teams of 2 for project work.

Students were allowed to choose their own game format, but needed significant guidance in selecting appropriate expressions to match. The tendency was to make the game as easy as possible, both to play and to design. Students were redirected toward more difficult expressions after the first day of game design.

Two class periods were provided for game design and construction, and several days outside of class were allowed. After preliminary review, games were returned with suggestions. The next day, teams made improvements and rule changes. One class period was provided for this, and final changes were discussed and made. On the next day, teams exchanged games and tested the rules and game play.

Many positive comments were made during the play of the games. Students were generally complimentary of the creativity of the games, and enjoyed playing them. They complimented one another and helped their opponents during play. Students actually seemed reluctant to stop at the end of the period. (Considering the makeup of the class, this was a huge victory.)

Generally board games seemed more difficult to design than card games. Depending on the level of the students, this may be a consideration when designing the assessment.

Cindy Kroon
9/15/04

Task Extensions

- Students could use easier or more complicated examples of algebraic phrases.
- Students could create a game using real numbers, exponential expressions, or like terms as the paired items.
- Students could match geometry definitions with a sketch, or vocabulary terms with a definition.

Appropriate Technology

- Internet connection with fast connection (dialup will be very slow)
- Students could use Word, Paint, etc. in game board and game piece construction.

Interdisciplinary Connections

Language Arts: Writing and following instructions, expository writing

Teacher Resources

Rubric creation

<http://rubistar.4teachers.org/index.php>

http://www.exemplars.com/math_rubric.html

National Library of Virtual Manipulatives

http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities

http://nlvm.usu.edu/en/nav/category_g_4_t_2.html

MERLOT Multimedia Educational Resource for Learning and Online Teaching

<http://www.merlot.org/Home.po>

Student Resources

National Library of Virtual Manipulatives

<http://nlvm.usu.edu/en/nav/index.html>

Algebra Tiles (9-12 Algebra link):

http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities

Resources

SD Mathematics Content Standards

<http://www.doe.sd.gov/contentstandards/math/index.asp>

SD Assessment and Testing

<http://www.doe.sd.gov/octa/assessment/index.asp>

The National Assessment of Educational Progress (NAEP)

<http://www.doe.sd.gov/octa/assessment/naep/index.asp>

National Council of Teachers of Mathematics

<http://nctm.org/>

Looking at Student Work

<http://www.lasw.org/index.html>